The biological pollutant pump: how a phytoplankton bloom alters the concentrations of organic chemicals in the marine environment

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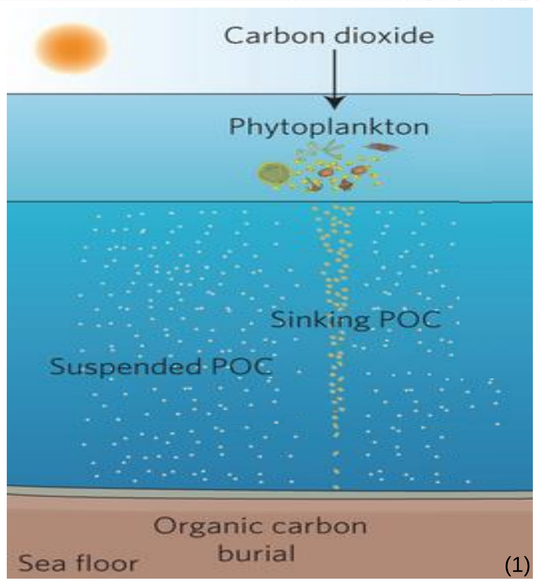
Introduction

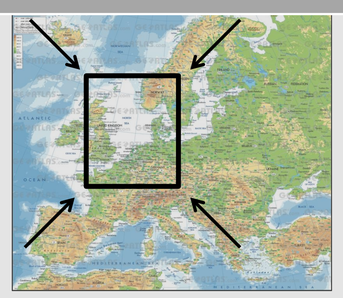


- The marine environment is a sink for many chemical substances
- The biological pump is the biologically driven (e.g. phytoplankton) sequestration of carbon from the atmosphere to the deep sea
- Empirical evidence of the role of the biological pollutant pump is often based on small spatial and temporal scales
- **Research question**
  - ➢ Do multidecadal field data support the biological pollutant pump theory?

Materials & Methods

Apply regression-based statistics on existing data and compare the inferred trends

1 Study area
North Sea



2 Monitoring data
Data via ICES repository (www.ices.dk)

Concentrations:
(1) Chlorophyll a
440 records (1975 – 2012)
(2) Sediment organic carbon
136 records (1990 – 2012)
(3) PCB concentrations
1,139 records (1994 – 2012)

3 Statistics
Regression-based analysis for each variable

Concentration
~ f( )
+ f( )

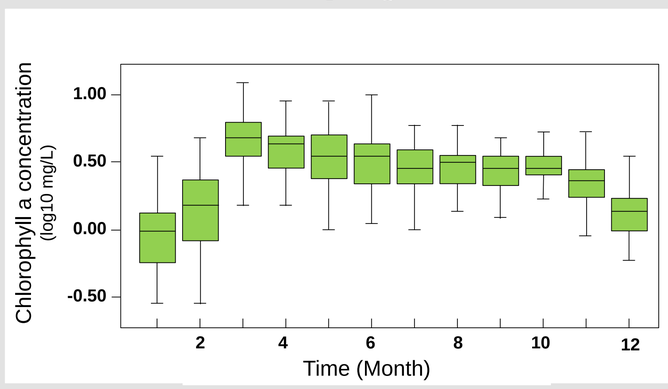
4 Coupling
Correlation analysis

Are these concentrations correlated?
(1) Chlorophyll a
(2) Sediment organic carbon
(3) PCBs

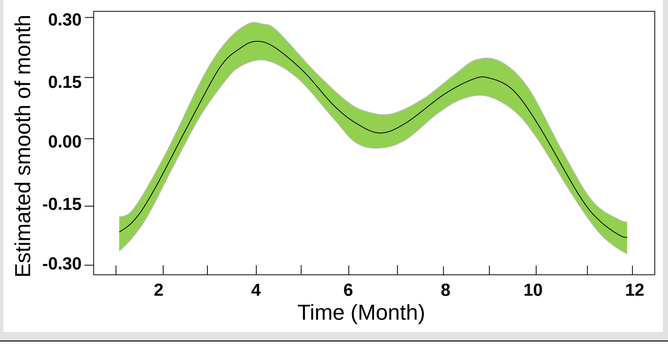
Results & Discussion

Chlorophyll a

Data exploration

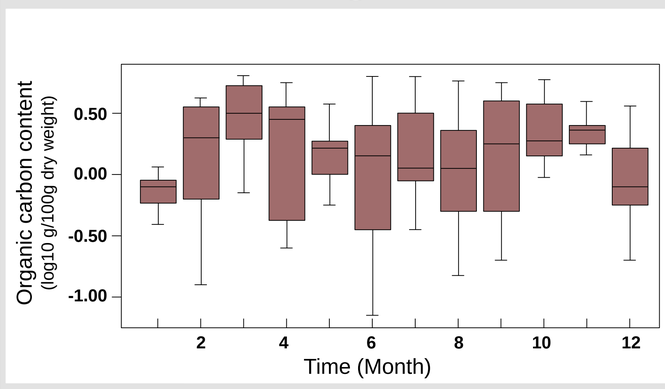


Regression-based analysis

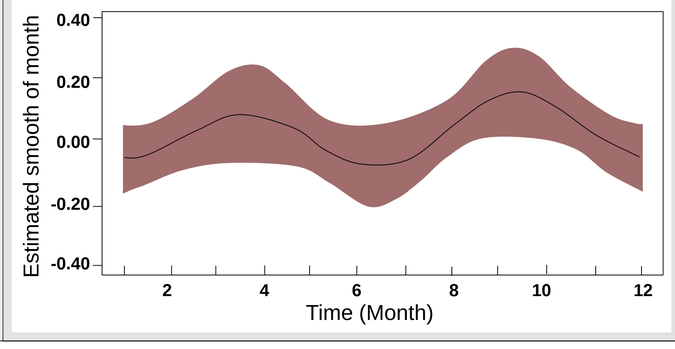


Sediment organic carbon

Data exploration

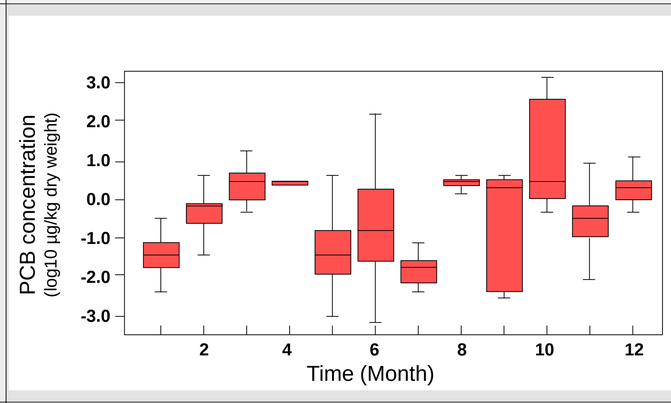


Regression-based analysis

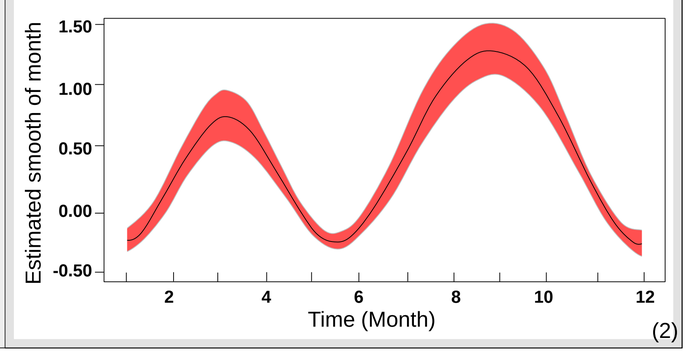


Sediment PCB

Data exploration



Regression-based analysis



(2)

- Boxplots & regression-based analyses: seasonal variations found in chlorophyll a, sediment organic carbon and PCB concentrations in sediment
- Correlation analysis: seasonal trends are coupled

Correlation analysis

	$[PCB]_{sediment}$	$[CHFLa]_{water}$
$[PCB]_{sediment}$	-	
$[CHFLa]_{water}$	**0.57** (0.004)	-
$[OC]_{sediment}$	**0.80** (<0.001)	**0.56** (0.004)

(2)

Conclusion

Large-scale spatio-temporal coupling between seasonal dynamics of phytoplankton, sediment organic carbon and PCB concentrations was observed and supported the biological pollutant pump theory

[1]Herndl et al., *Nat. Geosci*. 2013, 6, 718-724; [2] Everaert et al., *Environ. Sci. Technol.* 2015, 49, 8704-8711
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